NASA Administrator
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Transcript

Thank you. I have got to tell you, coming to California is wonderful. I rode on the bike path yesterday without dying, ~~of~~ heat overload, ~~and~~ high temperature, high humidity, ~~and~~ just the pressures of living inside the beltway.

Before I start, I would like to introduce a few people that are here with me from NASA. We have Dr. Robert Whitehead, who is the head of our Aeronautics Enterprise. Dr. Harry McDonald, who is the new director of NASA Ames Research Center, Sunnyvale. Sam Venneri, who is the head of our advanced spacecraft activity in NASA. We have Lee Holcomb, who is head of the Information Systems at NASA. We have Greg Gibbs, who followed me around the country and made sure I never get into trouble. Greg is in Public Affairs at NASA. We have the other members of the NASA team here that you might want to talk to during the course of the day. The rest of the NASA team please stand up so that we can see your terrific faces and your great brains.

In thinking about the programs that we have in and the partnerships, I think about a trip that I recently took to South America. I went down to South American with Secretary Christopher because of the tremendous changes taking place down there. The Cold War is over, and the countries in South America want to focus on advanced technology in building a new infrastructure.

During the course of the Cold War, there was a desire on part of some countries in South America to utilize space to develop weapons. In the case of Argentina, they had begun developing the Condor missle with Iraq, which was very threatening to the Western hemisphere. Brazil at one point in time, was thinking of building space launchers that could be converted into ballistic missiles, that could be exported, and there was some thought about it in Chile.

Hopefully, the Cold War is over and new possibilities have presented themselves. For a number of years, as the NASA Administrator, the Ambassador to the United States from Brazil would come see me and ask us to work together in space. I said, "We'd love to work together with you, but NASA is a civilian space Agency, and we're not interested in developing ballistic missile technology that can threaten humanity. What we're interested in doing is utilizing space and the vehicles to better humanity. So, if you will sign up to the Missile

Technology Control Regime, we at NASA, will be very happy."

The Missile Technology Control Regime is a covenant among nations not to involve in exporting, space technology for ballistic missiles. The fact of the matter is, Brazil signed up to it. Argentina wanted to renew the agreement, and Secretary Christopher asked me to join them in signing these agreements. The government of Chile wanted to work with us. We told them that we would be happy to work with them if they transfer their space program from a military to a civilian agency, because then we really could work together. We had a really exciting time.

When I went down there, I was surprised. I shouldn't have been, but Argentina has already built a spacecraft. It took three-and-a-half years for the first time from scratch. They never had an infrastructure. The second spacecraft was in construction for three years. The third spacecraft will be built in nine months.

Some companies in America that haven't gotten agile, some companies that want to hold onto the past and get back to the good old Apollo days, might want to learn from Argentina. Brazil has a space program that is $100 million a year, destined to go to about $200 million a year. They're so excited about the International Space Station, they have

volunteered that they'd like to bring some money to the International Space Station to participate.

We have a tendency to think of other developing countries as not having a technological infrastructure, not having the method of contributing to the overall scientific knowledge. I challenge everyone in this room not to think that way. I'll talk some more about that.

While I was down there working on these agreements, I was invited to visit an astronomical facility in Tololo, which is in Chile. It is up the coast from Santiago. We flew up to a little city called La Serena. We had a couple of 4-wheel drive vehicles waiting for us. We drove up to the mountains for a number of hours through dirt roads. We got there at sunset. We had to wait for the darkness so we could peer through the telescopes. I had been in the space business 32 years, and I had never peered through a telescope. I felt it was time. It was an incredible facility. There were people up there from all over the world, researchers working together in this collaborative relationship.

Just before sunset, we went onto the catwalk around one of the major telescopes which looks out to the ocean to watch the sunset. It was really powerful. Standing up on top of the telescope's mountains, we started to (~~inaudible~~) about what a great time it is to be alive. wax eloquent

The human species have peered out at the heavens for millennium, but right now we have the tools to seek planets around stars. It wasn't until six months ago that we were able to directly ~~effect the~~ planets around a nearby star. We didn't know if ~~it~~ they existed. In fact, a few of the planets that we found might be full of lichens. That is, water that exists where it is not necessarily frozen, it starts to vaporize because it is so hot. Wherever we find water on Earth, we have found lichens.

I'm not saying we've detected life, but what a time to be alive when we just revel in that. It is just unbelievably exciting. We talked about technology. We talked about the future. Then it got dark, and I had a chance to see ~~(inaudible)~~ 1987. ~~(inaudible)~~ is the death of a star. When a star dies, there's an unbelievable explosion that sends shock waves up in the heavens. The substance of life is generated in the stars. If you think of life cycles in a billion years' scale, it repeats itself just the way life does here. Because in the ~~(inaudible)~~, the substance of life is being spread throughout the heavens, and ~~then it can go back to~~ space where it then ~~(inaudible) less~~, new life.

After we had this inspirational activity, one of the directors there said, "You know, Dan, this is going to change." He said, "It's creative, it's inspirational to have our scientists come up to the telescope, but because of the things that are happening, virtual presence, you no longer need

(~~inaudible~~)." The productivity will go way up because we now can really do tasking and (~~inaudible) people in and out and~~ determine what places we want to look at the sky. You can sit in your laboratory; you don't need to be up here on the mountain, look at a digital display. With the new multimedia technology, it's going to be incredible, and in a limit, we'll just a few people to oil the telescope now.

This is going to be progress; so the lament was, God, we're going to lose the creative spirit. But on the other hand, think of the impact on humanity and the productivity to science that take these very expensive tools, and have scientist around the world operating them. In a limit, children at high schools will be able to bid on these things.

It used to be that science at NASA would be with the scientist and the scientist would demand one to two year hold on the data before they publish it. This is no longer going be the case because of the (~~inaudible) activity~~, because of compatibility of all the systems, ~~but~~ because of the unbelievable speeds. Because of the ability to do data mining, we're going to take our data and put it realtime on the Internet, available to anyone and everyone. (~~inaudible~~).

We had this dilemma, we wanted to hold on to the past. I loved being up on the mountain, but the fact of the matter is, the American public wants

more science for less money. We cannot leave it for the privileged few, ~~and~~ In fact, ~~they~~ might even inspire (~~inaudible~~). Young people ~~look at me and~~ said, "You're going to do the astrophysics; we're not just going to leave it to the domain of some professors that ~~they~~ get grants all the time." It's open. America is open to the world.

This is the message I have for you. We always look back to the past with unbelievable warmth and clarity and forget all the battle scars we had. As we look into the future, we get insecure about the changes that are coming that we want to reach back into the past, and we forget about all the problems that occurred. Now we can find dozens of reasons why it shouldn't happen, and I submit there are people who say, "If it ain't broke, don't fix it." First of all, that's bad English and second of all it's a very poor reason.

Let me talk a little about change because that's the subject of this conference. If you have to deal with change, you want to understand the forces that drive that change. I will at least, give you my best cut at this, and then I will come back, and I'll talk about the impact ~~of~~ California. (~~inaudible~~).

There are five basic forces that I believe that drive the change that are causing us a great anxiety that we are having right now. You want to get a sense to what it is like, what it's going to be in the next 10, 20, 30 years. Go back and take a look at what

happened to America as we went from an agricultural society to a manufacturing society. If you just change a few of the words, (~~inaudible~~), you will see the anxiety that is taking place today. So we think we're always unique, always be on the cutting edge. You can learn a lot from history. Let's take a look at what is happening today.

Force 1) The Cold War hopefully is over. "It's not over until it's over," as Yogi Berra said. Hopefully, we're transitioning out of the Cold War period into some new age that's yet to be defined--going from a period from competition to competition plus cooperation. I say that intentionally because if a nation must act in its own interest, and if it make sense for America to compete, then we'll compete. If it make sense for us to cooperate, we'll cooperate. That applies to corporations, and that applies to individuals.

So the Berlin Wall comes down and there's a signal that maybe the Cold War is over. Let's look at what the Cold War did to us. It was very clear that people have (~~inaudible~~) of long-term technological investments, investment in educational institutions and survival of America as a Nation. You didn't have to be a rocket scientist to understand that, so we were able to spend trillions of dollars. Take a look at what happened to the college campuses ~~from~~ the 1950's and 1960's. They didn't have to worry about downsizing. We were going to build the best and brightest minds in the country, train them, and send

them to the weapons factories. It made no difference whether you got trained as an astrophysicist or a high energy physicist. You fit into the culture in America, and I won't apologize for it. I think that it's great. I think we took on the Soviet Union and beat them.

The fact of the matter is, that's what drove us and now in our quest to try and understand why it's different now, you can't go back to where it was. You have to justify where you're going. So you just can't say to the American public, look, we have this great big machine, keep feeding it. Because the American public is saying, look, I understood, I was willing to build a national debt that would create a burden on my children so long as I was able to correlate technology for the survival of the Nation. Now, ~~the~~ Federal Government, and educational community, explain to me why we need this investment? Now, I'm not saying there isn't an answer, ~~but~~ I'm saying ~~those~~ that bemoan the fact that ~~did~~ not send ~~any~~ money to us. Those scientist and engineers ~~that~~ want to sit isolated in their laboratories and ~~to derelict~~ forget who the customer is--the American public, ~~Those who don't~~ want to be interrupted to write all their journal articles and make their great scientific discoveries better wake up and smell the coffee.

I want to tell you, I go to scientific meeting after scientific meeting and I ask people to raise their hands and I say, "How many people in the room

spend one hour a week in elementary, junior high, and high school?" Let's see how many people do that here? Raise your hands high, shame on everybody in this room, and then we bemoan education. We moan the fact that people don't understand the impact of science technology on America, because our feet are planted firmly in the Cold War, and we want Americans to understand that they have to invest in science and technology. This in my mind is the single biggest failing that we in the scientific and technology community have.

I was in industry for 25 years, and I was trained to listen to my customer. We are not listening to our customer. The problem is going to be, our customer needs to hear us because their future depends on it. Because I'll ~~be able to (inaudible)~~ a few more issues here. So education is impacted; the Government's role is impacted.

On the 25th Anniversary of the landing on the Moon, people came to me and said, "Dan, how ~~can~~ President Clinton ~~(inaudible) on the~~ announcement going on to Mars?" I said, "Why are we going to Mars?" Well, it's going to be great, it's going to be enjoyable. The last time NASA calculated what it would take to go to Mars on a feel-good mission, like Apollo. By the way, Apollo was a feel-good mission. We had to beat the Russians to the Moon. Don't believe anyone who tells you that it was done for science. We were going to demonstrate to the world that we had ballistic missiles that could blow up very

dangerous payloads, so don't be threatening us! We were demonstrating to the uncommitted countries that America was superior, ~~in technology~~, so you had better join with us. Once we got to the Moon we said, "Hey, we're here. What are we doing here?" and President Nixon rightfully shutdown the Moon project; there was no reason to go.

Then, NASA forgot to tell President Bush when he announced that we were going back to the Moon that it would only cost $400 billion and take 30 years. It's shameful, but people forgot about the customer--the American people. The Americans want to go to the Moon. They want to go to Mars. They want to go to asteroids. They want to explore space, but they also want to have a productive society. It would be shameful to take $400 billion for a feel-good mission with no purpose to go there. We were living in the Cold War, so they said, "Dan, why don't you go (~~inaudible~~) to Mars?" I said, "Not on your life!" Before we go to Mars, we had better figure out how to do it for a factor of 20 to 30 less money, then they estimated.

We had better find out if there is a scientific benefit. We had better find out if there's a commercial benefit, an economical benefit. We had better have a cost benefit ratio so we explain to our customer, the American people, why we're going. Our job is not to employ scientists and engineers so they can have fun. Our job is to open up the space frontier that will enrich life on Earth.

It's a new way of thinking, and unless the scientific community gets with it, we're going to disappoint America. We have so much to give, but we're not communicating with our customer, and during the Cold War, we didn't have to communicate with the customer because everyone could say science, technology, ~~I understand.~~ Survival, I understand. What people are trying to do was hold on to the past and hold on to the industrial base which means, you protect mediocrity. You keep the production lines open for our survival. We will destroy ourselves as the world's leading Nation in defense unless we let go of the industrial base and get into the future.

People are very frustrated. In California you deal with heat. We have to redefine our defense. We should be designing for the force of the year 2015, not holding on to industrial base; we get an agile military, and this is exactly what this debate is about. If we hold on to the defense to protect jobs, we've dodged on the issue.

I'm for a very strong defense.

~~We have to say who the customers are. I've worked very strong, and that's a~~ fact, I am very proud of the roll~~ing blade~~ in the military buildup. I am proud of the fact that I designed and developed weapons aimed against the Soviet Union to beat her back. It's not that I don't want defense. You can't have a defense program that's a jobs program. This is a very important issue to understand. That

applies to everything that NASA does and DoD doesn't (~~inaudible~~). OK, that is point one.

Point two, I'll put a log on the fire; it gets worse. I have (~~inaudible~~) five points, ladies and gentlemen. (~~Inaudible~~), ~~the cost of~~ the Cold War has hopefully ended, ~~and because we don't have to (inaudible) all the world.~~ You all know who your friends are, who your enemies are. The United States is worried about the proliferation ~~of registering~~ weapons with Russia, and Dr. Shannon Lucid is up in Mir Space Station, ~~lifeless.~~ Are they our friend or are they our competition? ~~Are they our enemies~~, we don't know. ~~They~~'re having hard times. But, what we do know is, unless you make the very best product, of the highest quality, at the lowest cost, it is never going to sell. You can have all of the protection in the world, but if you are not superior, technologically, if you're not superior in quality, manufacturing, in market distribution, you're not going to make it.

Let me give you an example of what I mean. I went to Circuit City, that good old electronic store that you go to. I walked in and a young kid with (~~inaudible~~) on his cheeks, walks up to me and says, "Hi." I said, "I'm going to replace my audio system," and he says, "Oh Great!" and sees dollars signs. Then he says to me, "What would you like?" I said, "Well, I have all these tapes and all these phonograph records, so I will need a tape player, a turntable, a tuner, and an amplifier." He was rolling on the floor. This was a year ago, and I bought it. So

what did I buy? I bought a CD; it is painful I have all these ~~(inaudible)~~ records, long playing disks. I had bought a VCR for the first time. ~~I'm into high tech, (inaudible) and~~ No sooner had I bought it than I thought "WOW, something else is coming down the pike." But the fact of the matter is that I asked for this equipment to be built in America. He rolls on the floor again. He says, "You've got to be kidding," I mean he got almost sarcastic. He said, "Don't you understand, America doesn't build this equipment anymore? They may have invented it, but they certainly don't build it anymore."

We can hoot and holler all we want about protecting this or that. But unless we have the leading edge technology that has some vision, 10 to 15 years out, ~~unless we productized~~, unless we have some partnerships between Government and industry, industry and industry, academia and industry, and we let go of the past and we don't ~~stay~~ ~~in~~ the past ~~because of the~~ job, and we reach out into the future, we are not going to make it in the global marketplace. We're going to desert our customer, the American people. So, I ask you to think about that.

Now, let me throw a ~~second~~ log on the fire. We're transitioning from a manufacturing age into an information age. Right now, 3 to 5 percent of our economy, based upon information ~~on health and technology, says that~~ In another one or two generations, it could be as much as 50 percent.

Think of ~~this location as going to the (inaudible)~~, think of the opportunities that are going to occur. Think of what could happen in California in terms of what you could do. Think of what America could do around the world. Half of the people in the world have never seen a phone; think of that. Then think about the possibilities of new markets opening up.

Again, I say to you, "If you want to hold on to the past and you want to lock into the good old days of the Cold War, forget it!" The best product, at the lowest cost will determine what happens in the marketplace. People are feeling ~~misplaced~~, so there is no wonder that everyone is uncomfortable. The information age says you can't be #14 in math and science, and in America, that's where we are and dropping fast. Children are becoming couch potatoes, but none of us are going to schools to participate. All of us want to cut the Federal Government. All of us want to cut the education budget, not vote for bond issues. None of us, corporately or individually are ~~(inaudible)~~.

I've been to 100 to 150 cities, and I've been in probably a few hundred schools. We can see one thing, we can see children in K through 3 with sparkle in their eyes. In grades 4 through 6, they begin to get a little sad; by junior and high school, you see deadness in their eyes. This is not going to lead us into the future with the kind of demographics we have. We had better pay attention to education. We'd better put our money

where our mouth is. If we want to cut the deficit, if we cut the budget, we'd better get involved.

Item 4. Technological obsoleteness. You remember I just bought my CD player. Within a year or two, they are going to integrate CD with video disks. So in 32 years, I had my first one; my second one was a CD, and within a year or two technological obsoleteness has come in. This has made people even ~~goofy~~. It is really a problem because there are companies that have been set up and have been there for decades making products, and in three weeks, they're out of business. So people who call for stability and saying, "Let's keep it stable, let's not change anything, let's just keep improving the processes", may or may not make it. You can be on the right train track going along thinking there is no interference, and it comes and hits you from the side and it's gone; it's gone.

If you read the New York Times on Tuesday, there was an article on what is happening in politics. It talks about the rapid reactions. There's cable networks in every (~~inaudible~~), the cable networks need a message. When babies went to bed, just 5, 10, 15 years ago, you could have a rest overnight. I never experienced this until I came into a high visibility job. I'm tethered to my beeper, and my portable phones and portable fax machine because news goes 24 hours a day. If you haven't read that article, read it. That's what happening; we're on a go-go pace, and change happens like that. If you are

in academia, industry, or Government, if you don't understand it, data ~~obsoleteness~~, technological ~~obsoleteness~~, if you want to hold onto stability, America will not be a good country. If America were bold, to take risk, but if you don't like to take risks, if you don't have failure, you're not going to get ~~this.~~ there. So, think about technological ~~obsoleteness.~~

I ask this question. Think about it because modern corporations have to turn around a quarter ~~in~~ a year. They don't have ability of long-term investments. They'll love you if their long-term plan is 3 to 5 years. I ask people, "What do you think is going to happen in America in the year 2020? Will it be a great Nation through the next century? Of course it will!" T~~rying to sell people who are optimistic is going to be~~ great for our children. I picked that year because that's the year my grandson becomes an astrophysicist with his doctorate from a great California university.

Then I ask the next question. Who is responsible for America in the year 2020? It's deadly silence because no one had any continuity into the future. This is where we really have to think about it. You ask a corporate chief executive, "Are you responsible for the corporation in the year 2020?" "I don't know if I am going to make it through the next year. How can I think about 2020?" If you asked this question of the Chief Executive Officer of AT&T, 30 to 40 years ago, he'd say, "Of

course, I'm responsible. I'm worried about the near term and long term."

Somehow, some way, we have got to figure out how to deal with this because we all want to have the opportunity for our children. With this go-go near-term performance, it isn't going to happen without some ~~form (inaudible)~~. For this reason and this reason alone, there needs to be some partnerships between academia that has some long vision. The Government, which has the stability for the long term funding, and industry, which ~~have a wide and open (inaudible) in~~ those activities. It is crucial that we understand this need, because if we don't understand this need, we will forever be chasing it ~~next to bees and butterflies.~~

Let me give you some statistics here just to give you the sense of how fast things are moving. Eighteen of 30 occupations in 1995 were not in the top 30 occupations, as late as 1960. In 1960, only three of the top 30 jobs required substantial education, today 12 of them do. On the 1960 list of the top jobs in America, these are the ones that are missing in 1995 ~~manufacturing labors~~, apparel, textile workers, assemblers, machinists, manufacturing checkers and examiners, packers, and wrappers.

In 1995, engineering moved to the top 10. In 1995, math and computer scientists, and computer programmers appeared for the first time. By 2001, only 9.7 jobs in America will be in the manufacturing

sector, down from 18 percent in 1987. Look at the demographics in America and then say, "Am I going to stand with my feet in the past trying to reach into the future, or try and get into the future and learn the best I have from the past."

Population of this planet grew from two billion when I was born, to six billion today. It took hundreds of thousands of years, billions of years to get to two billion people. In my lifetime, less than three generations, the population tripled. In another, perhaps two generations, it could go to 12 billion people. The thing that has kept us going and has kept ~~moldiness~~ in the ~~grate~~, and prevented it from coming out and saying, "I told you so, the ~~(inaudible) will turn to flies.~~ ~~It's a~~ fact that we have always stayed ahead of the game technologically, ~~but~~ we didn't focus on the 1, 2, 3 year ~~addition~~. As a Nation, we had a vision and we thought 10, 20, 30 years out. If we continue this go-go activity, where our focus is the next 1, 2, 3 years, because that's the only way ~~to operate and~~ make it ~~to~~ the global marketplace, what's going to happen to America?

So once again I say, "Scientists and engineers, managers and Government executives, we owe it to our customer, the American public, to make sure we communicate on this vision and deliver on the vision." I ~~could~~ tell you one organization that feels responsibility to the people of America and that's

NASA. Our budget could be cut today, and ~~it~~ we would not feel an impact on America for 10 years, maybe 15 years.

When I came to NASA, I started getting interested in direct broadcast TV. I left NASA in 1967 and had the privilege in 1971 of being one of the people ~~being~~ involved in the first experiment in direct broadcast TV--designed it in 1971, and launched it in 1976, and ran the first color TV patterns in the system. Twenty years later, there are two or three companies that are entering multimillion-dollar ~~offers~~ markets.

Now, if we had to demonstrate the bottom-line situation there, we had to go to Congress and say, "We're going to generate so many jobs in 10 to 15 years", they'd laugh us out of the place. In 1971, America had the vision to do something very difficult, very challenging at frequencies people had not operated at before, at bandwidths that we hadn't even thought about before. Twenty years later, it has had an impact. This is what NASA is about. We cannot exist on Tang and Velcro.

People ~~wanted~~ want me to go to justify to the Congress. We were going to go and build the Hubble Space Telescope; show me how it was going to impact America tomorrow. NASA is about rewriting physics textbooks. NASA is about rewriting chemistry textbooks. NASA is about rewriting biology textbooks. NASA is about inspiring people

the evil empire. Well, a funny thing happened in 1992, the budget was projected to go somewhere between $23 billion to $40 billion in the year 2000. The industry was go-go-go, and NASA's point was go-go-go. I arrived and I said, "Time out; I just spoke to the American people, and I spoke to members of Congress, and they said, "This is not going to happen." It was a very uncomfortable circumstance to be in because you ~~want to~~ make people happy when you tell them, "You will no longer grow but get cut." Better to tell the truth than live firmly in the past because we have been through all sorts of great things.

The only problem was in 1992, if you took a look at the average cost of our programs, they had grown 77 percent. In 1992, the average spacecraft cost $600 million. In 1989, we said it would take $400 billion to go to Mars. We had been working on the Space Station for eight years, spent $10 billion and didn't build one piece of hardware. Boy did we have fun, and boy did we make profits!

NASA, instead of being a leading-edge-technology organization, had people working in operations. We didn't have any major contracts that had performance requirements. We bought people on time and materials. It was more important that every time NASA procurements were announced, we asked, "How many jobs were in your district?" That is not what we're about. We're about understanding how to break through the air and space frontier and

enrich life here on Earth, and we don't apologize for it. We do understand that when you go reach out, 10 to 20 years into the future, it's ~~better be~~ that ~~counts~~.

We had ~~a~~ deal with all these issues. Let me give you the good ~~one~~. In 1996, our budget was cut 36 percent from the projection of 1992. We turned back $43 million that went into the deficit reduction ~~or~~ enriching other programs in the country--36 percent cut, and our productivity went up 40 percent. We started 33 new science and technology programs. Once we eliminated the programs ~~that~~ weren't performing, ~~you have to cancel~~ one science program, one technology program, ~~(inaudible)~~.

The average spacecraft cost is now $200 million, ~~and we predict~~ a goal of $75 million. We ~~will go~~ from two ~~orbits~~ a year, we are about eight ~~orbits~~ a year now, we're going to go to 12 ~~orbits~~. The average time to build a spacecraft used to take eight years, it now takes five years. Our goal is to get down to three. Ed Stone, of the Jet Propulsion Lab is taking a goal of 15 to 18 months from design to launch by the turn of the century. Spacecraft will cost tens of millions of dollars, not billions of dollars.

~~It takes years to get a Ph.D~~. I see Paul Coleman here from UCLA, he is worried about his students. At TRW we worked on the AXAF spacecraft. We started hiring people in 1978. ~~We came up here to (inaudible)~~. The spacecraft will not be launched until 1998. Data will come back at the turn of the

century, and the ~~year~~ brilliant post ~~doctorate~~ that we hired ~~(inaudible)~~ in 1978 will be old and gray and retired (inaudible). We tolerated it because it gave us stability, and it gave us jobs. People weren't bad, but that was the Cold War system. Now you have got to compete like crazy, and you have got to be very agile. We're talking about programs that turn around in a year and a half or two years.

Now, ~~you have a Masters Degree and~~ you can design a spacecraft and get a Masters Degree. Paul Coleman is developing a program with a spacecraft that costs $4 million. ~~He has~~ a test program ~~in~~ his organization, USRA, $4 million for a spacecraft, and we're trying to get a million-dollar launch, up to $60 million a year. We will have 12 university teams every year doing small spacecraft. They will build it on a desk, not in a high bay. The students will do all the work on it. This is what we are going to do, ~~no doubt.~~

Industry had better take note because we want them to be competitive, and they are not going to be competitive by maintaining an industrial base. We want them to go and do real risky things. Our goal is 10 times faster, 10 times better, and 10 times cheaper. Not smaller for less money, but better, cheaper, and faster. That's where we're going.

We intend in the next 10 years to ~~gradually~~ directly detect Earth-size planets, if they exist around tens of thousand of stars within 100 light years of Earth,

that's 600 billion miles. We intend to be able to remotely sense their environments, to see if there is oxygen, water vapor, carbon dioxide, and maybe if we're lucky, methane. If we have a significant ~~water and quality~~ of oxygen in comparison with carbon dioxide, that's ~~(inaudible)~~ photosynthesis. Maybe, it's not chlorophyll, maybe it's rhodopsin. It is a blue-purple planet, not a ~~(inaudible)~~. That's OK.

Within 25 years, we intend, if we can figure out how to do it, to ~~visit~~ planets, Earth size around the stars with a resolution high enough to ~~(inaudible) its~~ continents, ~~(inaudible) the planets.~~ Think about what that one picture will do, ~~(inaudible)~~. Now right away people saying, "Dan, how can you even think that way because it'll destroy peer-review science." Honest to goodness, this is the ~~(inaudible)~~ because science has got to go year to year and can't have a 25-year vision. This is coming from the scientists. You're going too fast. I want sweat beads on the foreheads of scientists. I want them to struggle and worry because if we can do this, we'll develop ~~(inaudible) things~~. We'll develop optical techniques. We'll develop surface-polishing techniques. We'll develop new materials. We'll develop computers the size of that glass that operate at a ~~(inaudible)~~ that don't take too much power. That will be a distributed system that can give us thinking spacecraft--learning ~~adapter~~ spacecraft.

Then you think about the impact on America. We ~~can~~ continue to hire people ~~to~~ job programs ~~so~~

or we ~~can~~ could try to take pictures of planets within ~~of~~ 100 light years from Earth. We can try and work cooperatively with the university community, with industry to do very tough things, and a lot of times we'll have failure and then we give heroes badges to people who fail and not to people who succeed. If you don't have failure, you don't make progress. We've become so risky ~~to~~ adversity ~~that~~ in this ~~whole~~ book country that we try so hard to prevent failures. We don't want to be ridiculed in the press. It is depressing ~~(inaudible).~~ the creative spirit ~~in~~ of America.

We intend to launch ~~(inaudible), a~~ two dozen a year, an armada of small spacecraft, ~~to (inaudible)~~ to our own solar system--every critical planetary body--to flyby, to orbit, to land, to rove and bring back samples. To build bases, ~~that~~ to have a virtual presence. By the way, in December of this year, we launch a spacecraft to Mars. We will land with a robot, and the robot has a capacity to see, think, ~~(inaudible) know~~, commands, ~~except well~~ from earth all except well ~~(inaudible)~~ say ~~to~~ go from point x to y ~~and~~ in an ancient ~~(inaudible~~) stream bed. It has the capacity to do it itself. By July 4 of next year, we will be on the Internet and the children of America will have virtual presence on Mars. You can get the weather report on Mars--cool and dry, no atmosphere.

to take no

Let me give you a sense. I went out to the Jet Propulsion Laboratory, that's a wonderful organization. They built the Galileo spacecraft. It just got to Jupiter in January. At the press conference someone said, "Space science at NASA

is dead because this is next to the last of the big observatories. We need big science." I said, "Isn't that interesting, the Galileo went to Jupiter, sent the probe to Jupiter to explore all it's moons. It only cost $2 billion, it ~~took a decade (inaudible)."~~

In 1993, with the unbelievable support of President Clinton, who wanted to take a risk, ~~He~~ was enabled and empowered NASA to start faster, better, cheaper. We started a program called NEAR--Near Asteroid Rendezvous Mission. We started that spacecraft in December of '93 and launched it 27 months later. The John Hopkins Applied Physics Lab said, "We don't want any reserve," and turned back $3.6 million. That spacecraft cost them $90 million and it's going out to the asteroid Eros.

We started the Mars Observer. We started the Mars Surveyor, which we're going to orbit around Mars. We started the Mars Pathfinder that is going to send a robot onto Mars. We started Mars Penetrator which is going to send little ~~penetrates~~ penetrators which ~~has~~ have a payload that will determine if water ~~is~~ on Mars and will also be a lander that's in an aeroshell, $10 million. Initially, they thought it would cost $2 billion. We start Mars Lander, in '98 and ~~Orbit in '98.~~ an orbiter in '98. These other two are going in '96. We started a program called Stardust that is going out to rendezvous with a comet, collect the dust from the comet's tail, and bring it back to Earth for analysis to see if there are amino acids, the building blocks of

life. We started the Lunar Prospector to search for water on the Moon, ~~and a few other. It's about 10 spacecraft.~~

We started Deep Space 1 which is going to give us electric propulsion. I started at NASA in '62 and worked on electric propulsion. The technology of the future ~~(inaudible)~~ to remain so forever. Finally, we revived it because we really wanted to help us in science. Then we started a program called Deep Space 2. It is going to be the first experiment in making distributed optic systems in space so we can begin to take ~~a few~~ pictures ~~of (inaudible)~~. Sum total of programs is $1.3 billion. The last spacecraft will be launched six years from the day ~~from the start of~~ the first ~~(inaudible)~~. I submit, it really works.

Is there stress at NASA? You bet. The place is ready to explode, and I love it because it is getting the creative juices flowing. We have scientists that are running these ~~visions~~. We actually went to the scientific community and said, "We've got no requirements, ~~and (inaudible)~~ before launch and then go figure out how to ~~get $3 million (inaudible)~~ and come back and challenge us."

We're building a Space Station. We redesigned the Space Station and again, President Clinton had the courage. He said, "This Space Station is not going to work. I'd like NASA to redesign it, and by the way, you've got about six months to do it." So we cut $20 billion out of the

program, ~~moved~~ set the schedule ~~of~~ in October 93. We're right on schedule to launch the first element in less than 18 months. We brought Russia in; ~~there're~~ not they're our competition anymore. We're not building the Space Station to get there before Russia. We are actually getting involved working with the Russians to prove that ~~we had a little (inaudible)~~. Now we can work together to enable people on this planet to have a rich life.

We are going to build robots that see, hear, speak, smell, feel temperature, feel texture, who are able to touch things and feel the temperature and pressures and have a ~~(inaudible)~~ and learn. We're going to use cyberspace to train these robots. We are going to teach robots how to do ~~(inaudible)~~ dexterous operations, ~~how they walk in cyberspace~~ because we have to send some of these robots a half million miles away where ~~and~~ we can't ~~(inaudible)~~ send people.

Think of the impact of the information industry in this country. We will have ~~verbal~~ virtual presence everywhere. We have to have wide-band data ~~(inaudible)~~ and communication systems that are orders ~~(inaudible)~~ of magnitude greater than what we have. We're looking at computers that are factors of 1,000 to ~~of~~ a billion greater capacity then ~~with~~ the speed that we have now. If you read Scientific America in January and a number of other articles, it says that we are nearing ~~taking (inaudible) to~~ the limits in terms of force and performance rate that we can get. That's if you

worry about the next two or three years. We need these things 10 to 15 years from now.

We are going to do a lot of things. We are going to build planes, planes that travel very slow speeds that go to 100,000 feet that stay in the air for months to sample our atmosphere ~~due to~~ and do chemistry ~~[illegible]~~ on in situ measurements ~~(inaudible)~~. We are going to develop planes to travel two and four times the speed of sound, from LA to Tokyo in 4 hours 20 minutes. We'll do the pre-competitive ~~(inaudible) thing in~~ technologies. They'll have combustion chambers that operate twice the temperature of any combustion chamber we have today, 3,000 degrees instead of our 1,570 degrees.

~~Normal metallic~~. We're going to build composites made out of ceramics and silicone carbides. Think of the kind of problems we have on a vehicle. When we solve that problem, think of the impact of fuel efficiency and other fields. Think of the new tools you're going to get out of it. We're going to build planes that travel Mach 24. We're working on them now. We're going to make it happen. We're building a rocket that ultimately will take people to space ~~(inaudible)~~. It is all going to be driven, not by the plume of rockets but by information and knowledge. This is why we're here in California.

We're developing Earth Sciences. It took us two and a half decades to get 25 terabytes of data ~~on the~~ remote sense of Earth. ~~When I finally (inaudible).~~

You want to talk about data line problems, (inaudible) and how we distribute tens of thousands of scientific statistics and hundred of thousands of static's on (inaudible). Think of the interactive bulky meter system and how to deal with that.

We ~~pretend~~ intend to be able, if we can, to go for disaster warning systems, long-term ~~predicted~~ predictive models, ~~(inaudible), with air.~~ We are ready to roll. We are going to make it happen. Right now, we are in the process of remodeling NASA Ames. ~~(Inaudible) sensor (inaudible), and we feel we~~ cannot do it ourselves.

During Apollo, we could go out and ~~do~~ build chip factories that ~~(inaudible)~~ cost millions of dollars, maybe hundreds of millions of dollars. We could develop new materials ~~and develop (inaudible).~~ Now chip factories cost billions of dollars, and its hopeless to expect the Federal Government to do that. What we want to do is ~~long~~ term relationships with industry--where we do the five, twenty long-term stuff and industry works in cooperation with us. They get the benefit of that research.

You can't go to a bank today and say, "Hey, I want $100 million, ~~and~~ because I want to see if I can build chips that operate 10 times faster than the chips we have, but I don't know if we can pay off for 15 years." We try and build these relationships, and then the good ~~thing that~~ for the Government ~~did~~ is, we ran some technology, ~~someone built a chip factory and sold~~

the chip to someone else. The Government (inaudible) small comfort and the (inaudible). We'll do it across the board.

We're looking for big time, hard-hitting applications and in (inaudible) on the part of some to want to hug onto the wind tunnels we have at NASA (inaudible). I don't have any bad feelings about that except I say, "You can't be impaired and play with old tools." We want to fly planes not just (inaudible). test in the wind tunnels

We intend to try this, and I can't guarantee it's going to be successful. I'm here in California because the Earth (inaudible) 50 states, and 30 percent of our procurement is in California. and 21% of our Education budget is here (Inaudible) I'm not here, but my heart is here (inaudible). I'm here because I want to give you (inaudible). I want to get you to think about 25 years out. I want to get you to think that there's hope for the future. I want to get you to think that Americans will be robust in the 21st build (inaudible) for this century, not because of what we did in the past, not because of the wars that we fought, not because of what we did, but because of what we're going to do in (inaudible) future.

So, why don't you go home tonight and ask yourself a question, "Is America going to be great in the year 2020?"

Thank you very much.

NASA Administrator
Daniel S. Goldin

California Coalition for Science & Technology Summit
Sacramento, CA
5/29/96
Transcript

Thank you. I have got to tell you, coming to California is wonderful. I rode on the bike path yesterday without dying. No heat overload, no high temperature, no high humidity, or just the pressures of living inside the beltway.

Before I start, I would like to introduce a few people that are here with me from NASA. We have Dr. Robert Whitehead, who is the head of our Aeronautics Enterprise. Dr. Harry McDonald, who is the new director of NASA Ames Research Center, Sunnyvale. Sam Venneri, who is the head of our Advanced Spacecraft Activity in NASA. We have Lee Holcomb, who is head of the Information Systems at NASA. We have Greg Gibbs, who follows me around the country and makes sure I never get into trouble. Greg is in Public Affairs at NASA. We have the other members of the NASA team here that you might want to talk to during the course of the day. The rest of the NASA team please stand up so that we can see your terrific faces and your great brains.

In thinking about the programs that we have and the partnerships, I think about a trip that I recently took to South America. I went down to South American with Secretary Christopher because of the tremendous changes taking place down there. The Cold War is over, and the countries in South America want to focus on advanced technology in building a new infrastructure.

During the course of the Cold War, there was a desire on part of some countries in South America to utilize space to develop weapons. In the case of Argentina, they had begun developing the Condor missile with Iraq, which was very threatening to the Western hemisphere. Brazil at one point in time, was thinking of building

space launchers that could be converted into ballistic missiles, that could be exported, and there was some thought about it in Chile.

Hopefully, the Cold War is over and new possibilities have presented themselves. For a number of years, as the NASA Administrator, the Ambassador to the United States from Brazil would come see me and ask us to work together in space. I said, "We'd love to work together with you, but NASA is a civilian space Agency, and we're not interested in developing ballistic missile technology that can threaten humanity. What we're interested in doing is utilizing space and the vehicles to better humanity. So, if you will sign up to the Missile Technology Control Regime, we at NASA, will be very happy to work with you."

The Missile Technology Control Regime is a covenant among nations not to get involved in exporting, space technology for ballistic missiles. The fact of the matter is, Brazil signed up to it. Argentina wanted to renew the agreement, and Secretary Christopher asked me to join them in signing these agreements.

The government of Chile wanted to work with us. We told them that we would be happy to work with them if they transfer their space program from a military to a civilian agency, because then we really could work together. We had a really exciting time.

When I went down there, I was surprised. I shouldn't have been, but Argentina has already built a spacecraft. It took three-and-a-half years for the first time from scratch. They never had an infrastructure. The second spacecraft was in construction for three years. The third spacecraft will be built in nine months.

Some companies in America that haven't gotten agile, some companies that want to hold onto the past and get back to the good old Apollo days, might want to learn from Argentina. Brazil has a space program that is $100 million a year, destined to go to about $200 million a year. They're so excited about the International Space Station, they have volunteered that they'd like to bring some money to the International Space Station to participate.

We have a tendency to think of other developing countries as not having a technological infrastructure, not having the method of contributing to the overall scientific knowledge. I challenge everyone in this room not to think that way. I'll talk some more about that.

While I was down there working on these agreements, I was invited to visit an astronomical facility in Tololo, which is in Chile. It is up the coast from Santiago. We flew up to a little city called La Serena. We had a couple of 4-wheel drive vehicles waiting for us. We drove up to the mountains for a number of hours through dirt roads. We got there at sunset. We had to wait for the darkness so we could peer through the telescopes. I had been in the space business 32 years, and I had never peered through a telescope. I felt it was time. It was an incredible facility. There were people up there from all over the world, researchers working together in this collaborative relationship.

Just before sunset, we went onto the catwalk around one of the major telescopes which looks out to the ocean to watch the sunset. It was really powerful. Standing up on top of the telescope's mountains, we started to wax eloquent about what a great time it is to be alive.

The human species have peered out at the heavens for millennium, but right now we have the tools to seek planets around stars. It wasn't until six months ago that we were able to directly detect planets around a nearby star. We didn't know if they existed. In fact, a few of the planets that we found might be full of lichens. That is, water that exists where it is not necessarily frozen, or starts to vaporize because it is so hot. Wherever we find water on Earth, we have found lichens.

I'm not saying we've detected life, but what a time to be alive when we can just revel in that. It is just unbelievably exciting. We talked about technology. We talked about the future. Then it got dark, and I had a chance to see Supernova 1987. A Supernova is the death of a star. When a star dies, there's an unbelievable explosion that sends shock waves up in the heavens. The substance of life is generated in the stars. If you think of life cycles in a billion years'

scale, it repeats itself just the way life does here. Because in the Supernova, the substance of life is being spread throughout the heavens, and integalactic space where it can then coalesce, into new life.

After we had this inspirational activity, one of the directors there said, "You know, Dan, this is going to change." He said, "It's creative, it's inspirational to have our scientists come up to the telescope, but because of the things that are happening with virtual presence, you no longer need to come to the mountain." The productivity will go way up because we now can really do tasking and determine what places we want to look at the sky. You can sit in your laboratory; you don't need to be up here on the mountain, you can just look at a digital display. With the new multimedia technology, it's going to be incredible, and in the limit, we'll need just a few people to oil the telescope now.

This is going to be progress; so the lament was, oh my, we're going to lose the creative spirit. But on the other hand, think of the impact on humanity and the productivity to science that take these very expensive tools, and have scientist around the world operating them. In the limit, children at high schools will be able to bid on these things.

It used to be that science at NASA would be with the scientist and the scientist would demand a one to two year hold on the data before they published it. This is no longer going be the case because of the interconductivity, because of compatibility of all the systems, because of the unbelievable speeds, and because of the ability to do data mining, we're going to take our data and put it realtime on the Internet, available to anyone and everyone.

We had this dilemma, we wanted to hold on to the past. I loved being up on the mountain, but the fact of the matter is, the American public wants more science for less money. We cannot leave it for the privileged few. In fact, we might even inspire young people if we said, "You're going to do the astrophysics; we're not just going to leave it to the domain of some professors that get grants all the time." It's open. America is open to the world.

This is the message I have for you. We always look back to the past with unbelievable warmth and clarity and forget all the battle scars we had. As we look into the future, we get insecure about the changes that are coming that we want to reach back into the past, and we forget about all the problems that occurred. Now we can find dozens of reasons why it shouldn't happen, and I submit there are people who say, "If it ain't broke, don't fix it." First of all, that's bad English and second of all it's a very poor reason.

Let me talk a little about change because that's the subject of this conference. If you have to deal with change, you want to understand the forces that drive that change. I will at least, give you my best cut at this, and then I will come back, and I'll talk about the impact on California.

There are five basic forces I believe that drive the change that is causing us a great anxiety that we are feeling right now. You want to get a sense of what it is like, what it's going to be like in the next 10, 20, 30 years. Go back and take a look at what happened to America as we went from an agricultural society to a manufacturing society. If you just change a few of the words in the press, you will see the anxiety that is taking place today. So we think we're always unique, always on the cutting edge. You can learn a lot from history. Let's take a look at what is happening today.

Force 1) The Cold War hopefully is over. "It's not over until it's over," as Yogi Berra said. Hopefully, we're transitioning out of the Cold War period into some new age that's yet to be defined--going from a period from competition to competition plus cooperation. I say that intentionally because if a nation must act in its own interest, and if it makes sense for America to compete, then we'll compete. If it make sense for us to cooperate, we'll cooperate. That applies to corporations, and that applies to individuals.

So the Berlin Wall comes down and there's a signal that maybe the Cold War is over. Let's look at what the Cold War did to us. It was very clear that people have a correlation of long-term technological investments, investment in educational institutions and survival of America as a Nation. You didn't have to be a rocket scientist to understand that, so we were able to spend trillions of

dollars. Take a look at what happened to the college campuses in the 1950's and 1960's. They didn't have to worry about downsizing. We were going to build the best and brightest minds in the country, train them, and send them to the weapons factories. It made no difference whether you got trained as an astrophysicist or a high energy physicist. You fit into the culture in America, and I won't apologize for it. I think that it's great. I think we took on the Soviet Union and beat them.

The fact of the matter is, that's what drove us and now in our quest to try and understand why it's different now, you can't go back to where it was. You have to justify where you're going. So you just can't say to the American public, look, we have this great big machine, keep feeding it. Because the American public is saying, look, I understood, I was willing to build a national debt that would create a burden on my children so long as I was able to correlate technology for the survival of the Nation. Now, Federal Government and educational community, explain to me why we need this investment? Now, I'm not saying there isn't an answer. I am saying those scientist and engineers that bemoan the fact that they're not sending the money to us and want to sit isolated in their laboratories and forget who the customer is--the American public, and want to be uninterrupted to write all their journal articles and make their great scientific discoveries, better wake up and smell the coffee.

I want to tell you, I go to scientific meeting after scientific meeting and I ask people to raise their hands and I say, "How many people in the room spend one hour a week in elementary, junior high, and high school?" Let's see how many people do that here? Raise your hands high, shame on everybody in this room, and then we bemoan education. We bemoan the fact that people don't understand the impact of science technology on America, because our feet are planted firmly in the Cold War, and we want Americans to understand that they have to invest in science and technology. This in my mind is the single biggest failing that we have in the scientific and technology community.

I was in industry for 25 years, and I was trained to listen to my customer. We are not listening to our customer. The problem is

going to be here and our customer needs to hear us because their future depends on it. So education is impacted; the Government's role is impacted.

On the 25th Anniversary of the landing on the Moon, people came to me and said, "Dan, how come President Clinton and you don't announce that we're going on to Mars?" I said, "Why are we going to Mars?" Well, it's going to be great, it's going to be enjoyable. By the way, Apollo was a feel-good mission. We had to beat the Russians to the Moon. Don't believe anyone who tells you that it was done for science. We were going to demonstrate to the world that we had ballistic missiles that could blow up very dangerous payloads, so don't be threatening us! We were demonstrating to the uncommitted countries that America was superior technologically, so you had better join with us. Once we got to the Moon we said, "Hey, we're here. What are we doing here?" and President Nixon rightfully shutdown the Moon project; there was no reason to go.

Then, NASA forgot to tell President Bush when he announced that we were going back to the Moon that it would only cost $400 billion and take 30 years. It's shameful, but people forgot about the customer--the American people. The Americans want to go to the Moon. They want to go to Mars. They want to go to asteroids. They want to explore space, but they also want to have a productive society. It would be shameful to take $400 billion for a feel-good mission with no purpose to go there. We were living in the Cold War, so they said, "Dan, why don't you go announce that we're going to Mars?" I said, "Not on your life!" Before we go to Mars, we had better figure out how to do it for a factor of 20 to 30 less money then previously estimated.

We had better find out if there is a scientific benefit. We had better find out if there's a commercial benefit, an economic benefit. We had better have a cost benefit ratio so we can explain to our customer, the American people, why we're going. Our job is not to employ scientists and engineers so they can have fun. Our job is to open up the space frontier that will enrich life on Earth.

It's a new way of thinking, and unless the scientific community gets with it, we're going to disappoint America. We have so much to give, but we're not communicating with our customer. During the Cold War, we didn't have to communicate with the customer because everyone could say science, technology, survival, I understand. What people are trying to do is hold on to the past and hold on to the industrial base which means, you protect mediocrity. If you keep the production lines open for our survival, we will destroy ourselves as the world's leading Nation in defense unless we let go of the industrial base and get into the future.

People are very frustrated. We have to redefine our defense. We should be designing for the force of the year 2015, not holding on to the industrial base; we need an agile military, and this is exactly what this debate is about. If we hold on to the defense to protect jobs, we've dodged on the issue.

I'm for a very strong defense. In fact, I am very proud of the roll I played in the military buildup. I am proud of the fact that I designed and developed weapons aimed against the Soviet Union to beat her back. It's not that I don't want defense. You can't have a defense program that's a jobs program. This is a very important issue to understand. That applies to everything that NASA does and DoD does and the Government does. OK, that is point one.

Point two, I'll put a log on the fire; it gets worse. I have five points, ladies and gentlemen. Globalization, because the Cold War has hopefully ended, you don't know who your friends are, or who your enemies are. The United States is worried about the proliferation of weapons with Russia, and Dr. Shannon Lucid is up in the Mir Space Station for five months. Are they our friend or are they our competition or enemy, we don't know. We're having a hard time. But, what we do know is, unless you make the very best product, of the highest quality, at the lowest cost, it is never going to sell. You can have all of the protection in the world, but if you are not superior, technologically, if you're not superior in quality, manufacturing, in market distribution, you're not going to make it.

Let me give you an example of what I mean. I walked in to Circuit City and a young kid with dew drops on his cheeks, walks up

to me and says, "Hi, what would you like?" I said, "I'm going to replace my audio system." He says, "Oh Great!" and sees dollars signs. Then he says to me, "What would you like?" I said, "Well, I have all these tapes and all these phonograph records, so I will need a tape player, a turntable, a tuner, and an amplifier." He was rolling on the floor. This was a year ago, and I bought it. So what did I buy? I bought a CD; it is painful because I have all these jazz records, long playing albums. I had bought a VCR for the first time. No sooner had I bought it than I thought "WOW, something else is coming down the pike." Then I asked if this equipment is be built in America. He rolls on the floor again. He says, "You've got to be kidding," I mean he got almost sarcastic. He said, "Don't you understand, America doesn't build this equipment anymore? They may have invented it, but they certainly don't build it anymore."

We can hoot and holler all we want about protecting this or that. But unless we have the leading edge technology that has some vision, 10 to 15 years out, unless we have some partnerships between Government and industry, industry and industry, academia and industry, and we let go of the past by reaching out into the future, we are not going to make it in the global marketplace. We're going to desert our customer, the American people. So, I ask you to think about that.

Now, let me throw a third log on the fire. We're transitioning from a manufacturing age into an information age. Right now, 3 to 5 percent of our economy, is based upon information intensive technologies. In another one or two generations, it could be as much as 50 percent. Think of the dislocation that is going to occur, but also think of the opportunities that will be available. Think of what could happen in California in terms of what you could do. Think of what America could do around the world. Half of the people in the world have never seen a phone; think of that. Then think about the possibilities of new markets opening up.

Again, I say to you, "If you want to hold on to the past and you want to lock into the good old days of the Cold War, forget it!" The best product, at the lowest cost will determine what happens in the marketplace. People are feeling displaced, so there is no wonder that everyone is uncomfortable.

The information age says you can't be #14 in math and science, and in America, that's where we are and dropping fast. Children are becoming couch potatoes, but none of us are going to schools to participate. All of us want to cut the Federal Government. All of us want to cut the education budget, not vote for bond issues, but none of us, corporately or individually are entering into schools.

I've been to 100 to 150 cities, and I've been in probably a few hundred schools. You can see one thing, you can see children in K through 3 with sparkle in their eyes. In grades 4 through 6, they begin to get a little sad; by junior and high school, you see deadness in their eyes. This is not going to lead us into the future with the kind of demographics we have. We had better pay attention to education. We'd better put our money where our mouth is. If we want to cut the deficit, if we cut the budget, we'd better get involved.

Item 4. Technological obsolescence. You remember I just bought my CD player. Within a year or two, they are going to integrate CD with video disks. So in 32 years, I had my first one; my second one was a CD, and within a year or two technological obsolescence has come in. This has made people even goofier. It is really a problem because there are companies that have been set up and have been there for decades making products, and in three weeks, they're out of business. So people who call for stability and say, "Let's keep it stable, let's not change anything, let's just keep improving the processes", may or may not make it. You can be on the right train track going along thinking there is no interference, and it comes and hits you from the side and it's gone; it's gone.

If you read the New York Times on Tuesday, there was an article on what is happening in politics. It talks about the rapid reactions. There are cable networks and in every half hour, the cable networks need a message. When babies went to bed, just 5, 10, 15 years ago, you could have a rest overnight. I never experienced this until I came into a high visibility job. I'm tethered to my beeper, and my portable phones and a portable fax machine because news goes 24 hours a day. If you haven't read that article, read it. That's what happening; we're on a go-go pace, and change happens like that. If you are in academia, industry, or Government, if you don't

understand, data obsolescence, or technological obsolescence, and if you want to hold onto stability, America will not be a good country. In America were bold and we take risk, but if you don't like to take risks, if you don't have failure, you're not going to get there. So, think about technological obsolescence.

I ask this question. Think about it because modern corporations have to turn around in a quarter a year. They don't have the ability of long-term investments. They'll love you if their long-term plan is 3 to 5 years. I ask people, "What do you think is going to happen in America in the year 2020? Will it be a great Nation through the next century?" They reply, "of course it will!" I picked that year because that's the year my grandson becomes an astrophysicist with his doctorate from a great California university.

Then I ask the next question. Who is responsible for America in the year 2020? It's deadly silence because no one had any continuity into the future. This is where we really have to think about it. You ask a corporate chief executive, "Are you responsible for the corporation in the year 2020?" And they say, "I don't know if I am going to make it through the next year. How can I think about 2020?" If you asked this question of the Chief Executive Officer of AT&T, 30 to 40 years ago, he'd say, "Of course, I'm responsible. I'm worried about the near term and long term."

Somehow, some way, we have got to figure out how to deal with this because we all want to have the opportunity for our children. With this go-go-go near-term performance, it isn't going to happen without some long-term stability. For this reason and this reason alone, there need to be some partnerships between academia that have some long vision. The Government, has the stability for the long-term funding, and industry, has to provide the ultimate productization of those activities. It is crucial that we understand this need, because if we don't understand this need, we will forever be chasing it.

Let me give you some statistics here just to give you the sense of how fast things are moving. Eighteen of 30 occupations in 1995 were not in the top 30 occupations, as late as 1960. In 1960, only three of the top 30 jobs required substantial education, today 12 of

them do. On the 1960 list of the top jobs in America, these are the ones that are missing in 1995--manufacturing laborers, apparel and textile workers, assemblers, machinists, manufacturing checkers and examiners, packers, and wrappers.

In 1995, engineering moved into the top 10. In 1995, math and computer scientists, and computer programmers appeared for the first time. By 2001, only 9.7 percent of the jobs in America will be in the manufacturing sector, down from 18 percent in 1987. Look at the demographics in America and then say, "Am I going to stand with my feet in the past trying to reach into the future, or try and get into the future and learn the best I have from the past."

Fifth Point - The population of this planet grew from two billion when I was born, to six billion today. It took hundreds of thousands of years, billions of years to get to two billion people. In my lifetime, less than three generations, the population tripled. In another, perhaps two generations, it could go to 12 billion people. The thing that has kept us going and has kept Mathus in the grave, and prevented him from coming out and saying, "I told you so, the Law of Diminishing Returns applies," is the fact that we have always stayed ahead of the game technologically. We didn't focus on the 1, 2, 3 year issue but as a Nation, we had a vision and we thought 10, 20, 30 years out. If we continue this go-go activity, where our focus is the next 1, 2, 3 years, because that's the only way corporations can make it in the global marketplace, what's going to happen to America?

So once again I say, "Scientists and engineers, managers and Government executives, we owe it to our customer, the American public, to make sure we communicate on this vision and deliver on the vision." I can tell you one organization that feels responsibility to the people of America and that's NASA. Our budget could be cut today, and we in America would not feel an impact for 10 years, maybe 15 years.

When I came to NASA, I started getting interested in direct broadcast TV. I left NASA in 1967 and had the privilege in 1971 of being one of the people involved in the first experiment in direct broadcast TV. We designed it in 1971, launched it in 1976, and ran the

first color TV patterns in the system. Twenty years later, there are two or three companies that are entering multi-million-dollar markets.

Now, if we had to demonstrate the bottom-line situation there, if we had to go to Congress and say, "We're going to generate so many jobs in 10 to 15 years", they would have laughed us out of the place. In 1971, America had the vision to do something very difficult, very challenging at frequencies people had not operated at before, at bandwidths that we hadn't even thought about before. Twenty years later, it has had an impact. This is what NASA is about. We cannot exist on Tang and Velcro.

People want me to go justify to the Congress the short term benefits. We were going to go and build the Hubble Space Telescope, so that would mean showing how it was going to impact America tomorrow. NASA is about rewriting physics textbooks. NASA is about rewriting chemistry textbooks. NASA is about rewriting biology textbooks. NASA is about inspiring people because in addition to the needs of survival--housing and shelter--we need intellectual nourishment, we're a human species.

We want to know is life unique to this planet. We want to know how galaxies, stars, and planets formed. We want to understand the interaction of the land mass, oceans, the atmosphere, the human species and the forces of nature so we can make predictive climatic models. We want to understand the El Nino condition, which impacts 39 crops in 33 countries. It is causing devastation on other continents and devastation in the United States. We need not to go to the Farmers Almanac and guess. We need to build predictive climatic models that are available on a regional, local, and global basis, so we can better manage these resources if the population is going to double. We don't have to apologize for it, and we don't have to tell America that we're going to get Tang and Velcro.

We should not apologize for basic science. That is what we're about. So NASA is there; we're responsible for America in the year 2020. We stand up for it, and we don't apologize for it. We are here to inspire our young people, to touch them, to give people goose bumps because that's part of life also.

The budget doubled from 1983 to 1992 because people had the technology-survival of America correlation, and understood the need to defeat the evil empire. Well, a funny thing happened in 1992, the budget was projected to go somewhere between $23 billion to $40 billion in the year 2000. The industry was go-go-go, and NASA's point was go-go-go. I arrived and I said, "Time out; I just spoke to the American people, and I spoke to members of Congress, and they said, This is not going to happen!" It was a very uncomfortable circumstance to be in because you don't make people happy when you tell them, "You will no longer grow but get cut." Better to tell the truth than live firmly in the past because we have been through all sorts of great things.

The only problem was in 1992, if you took a look at the average cost of our programs, they had grown 77 percent. In 1992, the average spacecraft cost $600 million. In 1989, we said it would take $400 billion to go to Mars. We had been working on the Space Station for eight years, spent $10 billion and didn't build one piece of hardware. Boy did we have fun, and boy did we make profits!

NASA, instead of being a leading-edge-technology organization, had people working in operations. We didn't have any major contracts that had performance requirements. It was more important that every time NASA procurements were announced we asked, "How many jobs were in your district?" That is not what we're about. We're about understanding how to break through the air and space frontier and enrich life here on Earth, and we don't apologize for it. We do understand that when you go reach out, 10 to 20 years into the future, it's benefits that come.

We had to deal with all these issues. Let me give you the good news. In 1996, our budget was cut 36 percent from the projection of 1992. We turned back $43 billion that went into the deficit reduction or enriching other programs in the country--36 percent cut, and our productivity went up 40 percent. We started 33 new science and technology programs. Once we eliminated the programs that weren't performing, we haven't canceled one science program or one technology program of significance.

The average spacecraft cost is now $200 million, and we've taken a goal of $75 million. We've gone from two launches a year, we are at about eight launches a year now, we're going to go to 12 launches a year. The average time to build a spacecraft used to take eight years, it now takes five years and our goal is to get down to three. Ed Stone, of the Jet Propulsion Lab is taking a goal of 15 to 18 months from design to launch by the turn of the century. Spacecraft will cost tens of millions of dollars, not billions of dollars.

I see Paul Coleman here from UCLA, he is worried about his students. At TRW we worked on the AXAF spacecraft and started hiring people in 1978. The spacecraft will not be launched until 1998. Data will come back at the turn of the century, and the young brilliant post docs that we hired in 1978 will be old and gray and retired when they write their final report on that program. We tolerated it because it gave us stability, and it gave us jobs. People weren't bad, but that was the Cold War system. Now you have got to compete like crazy, and you have got to be very agile. We're talking about programs that turn around in a year and a half or two years.

Now you can design a spacecraft and get a Masters Degree. Paul Coleman is developing a program with spacecraft that cost $4 million. We have a test program with his organization, USRA, $4 million for a spacecraft, and we're trying to get a million-dollar launch. For up to $60 million a year, we will have 12 university teams every year doing small spacecraft. They will build it on a desk, not in a high bay. The students will do all the work on it. This is what we are going to do.

Industry had better take note because we want them to be competitive, and they are not going to be competitive by maintaining an industrial base. We want them to go and do real risky things. Our goal is 10 times faster, 10 times better, and 10 times cheaper. Not smaller for less money, but better, cheaper, and faster. That's where we're going.

We intend in the next 10 years to directly detect Earth-size planets, if they exist around tens of thousand of stars within 100 light years of Earth, that's 600 billion miles. We intend to be able to

remotely sense their environments, to see if there is oxygen, water vapor, carbon dioxide, and maybe if we're lucky, methane. If we have a significant quantity of oxygen in comparison with carbon dioxide, that's out of chemical equilibrium, we know of only one process that could do that - photosynthesis. Maybe, it's not chlorophyll, maybe it's rhodopsin. If it is a blue-purple planet, not a blue-green planet, that's ok.

Within 25 years, we intend, if we can figure out how to do it, to image planets Earth size, around these stars with a resolution high enough to see oceans and continents, mountain ranges and clouds. Think about what that one picture will do. Now right away people are saying, "Dan, how can you even think that way because it'll destroy peer-review science." Honest to goodness, this is the complaint because science has got to go year to year and can't have a 25-year vision. This is coming from the scientists. I want sweat beads on the foreheads of scientists. I want them to struggle and worry because if we can do this, we'll develop metrology techniques. We'll develop optical techniques. We'll develop surface-polishing techniques. We'll develop new materials. We'll develop computers the size of that glass that operate at a peta flop, don't take too much power, and that will be a distributed system that can give us thinking spacecraft--learning adaptive spacecraft.

Then think about the impact on America. We could continue to hire people for jobs programs or we could try to take pictures of planets within 100 light years from Earth. We can try and work cooperatively with the university community and industry to do very tough things, and a lot of times we'll have failure. We should give heroes badges to people who fail. If you don't have failure, you don't make progress. We've become so risk adverse in this bold country and we try so hard to prevent failures because we don't want to be ridiculed in the press that it is depressing the creative spirit of America.

We intend to launch an armada of small spacecraft, two dozen a year, to our own solar system--every critical planetary body--to flyby, to orbit, to land, to rove and bring back samples. To build bases, to have a virtual presence. By the way, in December of this year, we launched a spacecraft to Mars. We will land with a robot,

and the robot has a capacity to see, think, to take no commands from Earth, except for example, we'll say go from point x to y in an ancient stream bed. It has the capacity to do it itself. By July 4 of next year, we will be on the Internet and the children of America will have virtual presence on Mars. You can get the weather report on Mars--cool and dry, no atmosphere.

Let me give you a sense. I went out to the Jet Propulsion Laboratory, that's a wonderful organization. They built the Galileo spacecraft. It just got to Jupiter in January. At the press conference someone said, "Space science at NASA is dead because this is next to the last of the big observatories. We need big science." I said, "Isn't that interesting. Galileo went to Jupiter, sent the probe to Jupiter to explore all it's moons. It only cost $2 billion."

In 1993, with the unbelievable support of President Clinton, who wanted to take a risk, NASA was enabled and empowered to start faster, better, cheaper. We started a program called NEAR--Near Asteroid Rendezvous Mission. We started that spacecraft in December of '93 and launched it 27 months later. The John Hopkins Applied Physics Lab said, "We don't want any reserve," and turned back $3.6 million. That spacecraft cost them $90 million and it's going out to the asteroid Eros.

We started the Mars Globel Surveyor, which we're going to orbit around Mars. We started the Mars Pathfinder that is going to send a robot onto Mars. Initially, they thought it would cost $2 billion. We start Mars Lander, in '98 and an orbiter in '98. These other two are going in '96. We started Mars Penetrator which is going to send little penetrators which have a payload that will determine if there is water on Mars and will also be a lander that's in an aeroshell, $10 million. We started a program called Stardust that is going out to rendezvous with a comet, collect the dust from the comet's tail, and bring it back to Earth for analysis to see if there are amino acids, the building blocks of life. We started the Lunar Prospector to search for water on the Moon.

We started Deep Space 1 which is going to give us electric propulsion. I started at NASA in '62 and worked on electric propulsion. The technology of the future doomed to remain so

forever. Finally, we revived it because we really wanted it to help us in science. Then we started a program called Deep Space 2. It is going to be the first experiment in distributed optical systems in space so we can begin to take these pictures I told you about. Sum total of those programs is $1.3 billion. The last spacecraft will be launched six years from the day, we started the first one. I submit, it really works.

Is there stress at NASA? You bet. The place is ready to explode, and I love it because it is getting the creative juices flowing. We have scientists that are running these missions. We actually went to the scientific community and said, "We've got no requirements. We have a peer review process."

We're building a Space Station. We redesigned the Space Station and again, President Clinton had the courage. He said, "This Space Station is not going to work. I'd like NASA to redesign it, and by the way, you've got about six months to do it." So we cut $20 billion out of the program, set the schedule in October 93. We're right on schedule to launch the first element in less than 18 months. We brought Russia in; they're not our competition anymore. We're not building the Space Station to get there before Russia. We are actually getting involved working with the Russians to prove that now we can work together to enable people on this planet to have a rich life.

We are going to build robots that see, hear, speak, smell, feel temperature, feel texture, who are able to touch things and feel the temperature and pressures and have a feedback so it doesn't damage anything and learn from experiences. We're going to use cyberspace to train these robots. We are going to teach robots how to do dexterous operations, because we have to send some of these robots a half million miles away where we can't send people.

Think of the impact on the information industry in this country. We will have virtual presence everywhere. We have to have wide-band data and communication systems that are orders of magnitude greater than what we have. We're looking at computers that are factors of 1,000 to a billion greater capacity then the speed that we have now. If you read Scientific America in January and a number of

other articles, it says that we are nearing the limits in terms of force and performance rate that we can get out of computer chips. That's if you worry about the next two or three years. We need these things 10 to 15 years from now.

We are going to do a lot of things and we'll do the pre-competitive technology. We are going to build planes, planes that travel at very slow speeds that go to 100,000 feet that stay in the air for months to sample our atmosphere and do chemistry with in situ measurements. We are going to develop planes to travel two and four times the speed of sound, from LA to Tokyo in 4 hours 20 minutes. They'll have combustion chambers that operate twice the temperature of any combustion chamber we have today, 3,000 degrees instead of our 1,570 degrees.

We're going to build composites made out of ceramics and silicon carbide. Think of the kind of problems we have on a vehicle with those materials. When we solve that problem, think of the impact on fuel efficiency and in other fields. Think of the new tools you're going to get out of it. We're going to build planes that travel Mach 24. We're working on them now. We're going to make it happen. It is all going to be driven, not by the plume of rockets but by information and knowledge. This is why we're here in California.

We're developing Earth Sciences. It took us two and a half decades to get 25 terabytes of data remotely sensed of Earth.

We intend to be able, if we can, to develop disaster warning systems, long-term predictive models of climate. We are ready to roll. We are going to make it happen. Right now, we are in the process of remodeling NASA Ames. Which is right here in the middle of Silicon Valley and we feel we cannot do it ourselves.

During Apollo, we could go out and build chip factories that cost millions of dollars, maybe hundreds of millions of dollars. We could develop new materials. Now chip factories cost billions of dollars, and its hopeless to expect the Federal Government to do that. What we want to do is form relationships with industry--where we do the five to twenty year long-term stuff and industry works in cooperation with us. They get the benefit of that research.

You can't go to a bank today and say, "Hey, I want $100 million because I want to see if I can build chips that operate 10 times faster than the chips we have, but I don't know if we can pay off for 15 years."

We're looking for big time, hard-hitting applications. We want to fly planes not just test in the wind tunnels.

We intend to try this, and I can't guarantee it's going to be successful. I'm here in California because out of 50 states, 30 percent of our procurement budget is in California and 21 percent of our Education budget is here. I'm here because I want to get you to think about 25 years out. I want to get you to think that there's hope for the future. I want to get you to think that America will be robust in the 21st century, not because of what we did in the past, not because of the wars that we fought, but because of what we're going to do to impact the future.

So, why don't you go home tonight and ask yourself a question, "Is America going to be great in the year 2020?"

Thank you very much.

NASA Administrator
Daniel S. Goldin

DRAFT of Prepared Remarks to:

The 1996 California Coalition for
Science and Technology Summit

Sacramento, California
May 29, 1996

Good afternoon. I am delighted to be here with you today. Most particularly so because the ideas that are the underpinnings of this summit -- response to change and reinvention of the organization -- are matters that are near and dear to my heart. As I am sure you are aware, they are what we have been doing at NASA since the day I became Administrator in April of 1992. And they are what we continue to do on a daily basis. With great success, I might add!

Your goals at this summit are "forging alliances," "improving support for science and technology," "developing a knowledge-based economy," and "building partnerships for California's future." To which I say, "yes, yes, YES!" I applaud you wholeheartedly. That is forward thinking. It is survival. And, ultimately, it is inevitable. But it is not where most corporate organizations, academic institutions or government agencies were headed just a few short years ago. Or, indeed, where many are headed even now!

Before I go further, I would like to share with you some of the experiences I had during several weeks in April when Congress was in recess and I had the opportunity to spend a good part of each day talking to elementary, middle school, high school and college students. What a rush! If any of you think that there isn't tremendous excitement in America about the future, try talking with the youth of our country for a few weeks. You'll come alive!

Two things, in particular, struck me. These kids didn't want to LISTEN; this next generation is "hands on." They wanted to SHOW me what they could do -- with computers, with NASA data and images, with remote sensing and with environmental analyses. And, they were good! I was truly impressed. Today's kids aren't intimidated by technology and change. They embrace it! And they are just as

fascinated with space and the unknown as any generation that went before them. And that's as it should be.

The second thing I noticed is that our children aren't stuck in the death knell that is the "status quo." They aren't constrained by artificial boundaries; they don't even SEE boundaries. They dare to hope, to believe and to dream. It's really inspirational, and it's a lesson we could all learn from. We had better!

But, that wasn't the picture I saw when I came to NASA in 1992. I won't dwell on the past, but this Agency had even lost sight of who its customers were. NASA's customers are not the aerospace companies, scientists, engineers or universities. THE customer for NASA is the American people, the tax payer who funds the programs, the people who NEED the benefits that result decades out. This is where the emphasis should and MUST be.

Now, don't get me wrong. NASA shouldn't have to justify every space and aeronautics program in terms of its return to America TODAY. That is not what NASA is about. Nor is NASA about technology transfer. If you want a technology transfer organization, go to private industry, don't come to the Federal government. Don't try to buy technology by the yard.

NASA is about bold and noble tasks to open the air and space frontier. It's about research that goes out 10, 20, 30 or even 100 years. And it's about the possibility of payoff that we don't even yet know about! NASA is about exploring the unknown. And we make no apology for this. If we are going to have a robust economy in the year, say, 2020, it is legitimate and necessary that this nation expend a very small fraction of its resources on things that go out that far.

But how do we get there? American corporations face terrific competitive pressures. They can't have an R&D program that goes out much beyond 5 years for product development. They can't go back to their shareholders and carry investments on the books for 20 years out. That's unrealistic. And that's why NASA is SO important.

As an Agency, we can and MUST explore the unknown. We must seek to answer the fundamental questions that the human species has been concerned with for centuries. And, in so doing, we will capture the imagination of our youth. We will enrich our knowledge base. We will revitalize our industries. We will uplift the American

spirit. And we will perform the basic research and technology development that will give us our ultimate payoff!

That is what NASA must do. That is where I am determined to take this Agency. And that is why partnerships with industry and academia are so vital. Let me give you just one example of what I am talking about.

Anyone who has Internet access, a television, or even just a daily newspaper now knows all about the cosmos from the images of the Hubble Space Telescope. Within the last year, we have photographed a planet around a star between 30 and 40 light years distant from Earth, and that planet is in "the life zone." We have even developed images of galaxies that we believe go back to the very beginning of existence. THAT is exploring the unknown. THAT is research. And THAT is intellectual nourishment for the American public.

But, when we take pictures of galaxies and stars that distant, we are picking out very faint light against a background of very high noise. This requires extremely advanced digital image processing techniques. This same technology now allows doctors to perform mammograms with much improved resolution and greater precision, to detect problems much earlier, and to treat them at significantly lower cost and often without painful surgery. THAT is payoff.

But to do these sorts of things, to reap these benefits, we must, as a Nation, be prepared to make the investment. We must go to the outer boundaries. We must explore the unknown.

But to explore the unknown, NASA had to be restructured. We have to continue to DREAM. But, we have to dream within the context of the reality of smaller budgets. NASA had to become very efficient. And the first step in doing that was having a vision -- deciding what our science goals are.

To that end, we talked to our customers across the country in a series of town hall meetings. We concluded that it is essential that we answer four basic questions. Let me just talk with you about them for a few moments:

- First, how did galaxies, stars, solar systems and planetary bodies of all kinds form and evolve? What are the processes associated with these transformations? How do we measure the very

parameters that define our universe (its size, age, shape and composition)?

- Second, is life of any form, however lowly or complex, carbon-based or other, unique to planet Earth?

- Third, by looking out at other planetary bodies and down at our own Earth, can we develop predictive environmental, climate, natural disaster, resource identification and resource management models to help ensure sustainable development and a high quality of life?

- And, finally, can we develop the aviation technology that provides fast, affordable and safe transportation to enrich the cultural and economic lives of all of the world's people while preserving the environment and promoting enhanced global security?

To even begin to answer these BIG questions, we have another set of issues, the "enabling" questions if you will, that we must address in our pursuit of NASA's vision. These are:

- How can we develop the affordable tools that we need to achieve our goals? Specifically:

  - How can we improve the safety, affordability, maneuverability, comfort and speed, and reduce the environmental impacts of traveling through air and space? How do we do that?

  - What cutting edge processes, technologies and techniques will allow us to answer these questions in the most productive, affordable and timely manner?

  - And, how can the knowledge we gain from our discoveries be most effectively transferred to commercial ventures in air, space and on our own planet?

- How do we most effectively communicate the knowledge we gain to the American people to educate them and provide opportunities?

- Finally, how can we foster new understanding among the nations of the world and improve the productivity of our space and aeronautics programs through international cooperation while, at

the same time, safeguarding high priority American interests and protecting the investment of our customer, the American tax payer?

These are our big questions and our enabling questions. Developing answers to them is a tall order, indeed. But, this is our vision. This is the basis from which we develop our missions. This is the direction that we are going in NASA. And it is the right direction!

Now, the truth is we probably won't have the answers to all of these questions any time soon. They really are BIG questions. It will take NASA and you, our partners, some time, possibly decades, to find answers to these questions. But, we are doing all of the right things that must be done to FIND the answers, and that is the key!

So, what are we doing you might ask? The answer is A LOT. This is an exciting time to be at NASA. All of our future missions are derived from our vision, seeking to answer fundamental questions about the heavens and Earth. We also face the challenges of new projects and new ways of doing business. The NASA of today is very different from the NASA of just four or five years ago.

What is different? Well, for one thing budgets! In the 1980s, NASA's budget soared, doubling between 1983 and 1993. The Augustine commission that reviewed NASA projected a budget for the Agency of well over $40 billion by the beginning of the next century. $40 billion! In retrospect, it almost seems laughable. It won't be close to that. In fact, it's going to be just about one third of that now-rosy prediction.

In the last few years, NASA has cut its budget requirements through the year 2000 by 36%. When you look at the Agency budget in historical perspective, the change is even greater. During the Apollo era, NASA's funding constituted 4.5% of the Federal budget. Today, it is nine-tenths of 1 percent of that budget, about one-fifth of its previous level, and it is still declining in both absolute and real terms.

So, NASA must be dead, right! Or, at least, on its knees! Well, I'm proud to say that, if you think that, you couldn't be more WRONG. The fact is, we made a conscious decision at NASA to change, to move with the times, to become more efficient. To lead the charge toward a leaner, more productive, more responsible, more cost-conscious

government. To fully embrace the concept of change. To make the slogan "faster, better cheaper" something that we live by every day in all of our missions. And we are succeeding. Perhaps, even beyond our most optimistic expectations.

Our budget has been reduced more than one third. We are downsizing by 55,000 out of a total workforce of 215,000. And yet our productivity is UP by 40 percent. We have reduced cost overruns in our major programs that averaged 77 percent in 1992, according to General Accounting Office audits, to negative 5 percent. That's right. 5% LESS than projected costs. We have reduced the cost of an average spacecraft from $600 million in 1994 to $200 million today, with a goal of $75 million by the turn of the century.

We have reduced life-cycle time in our major programs from 8 years to the current five, with three as our goal. In the planetary program, we are even aiming for a target of one-year-and-a-half from design to launch.

Our reliability is up, our costs are down, and our productivity is soaring. How have we achieved all this? The answer is be found in the basic restructuring that we have conducted at the Agency.

The first thing that we did was to change our course. To let loose of the old way of doing business. To repudiate the status quo. To actually TALK to the American people. It quickly became apparent that our real customers still care passionately about NASA and what we do. We were told repeatedly that they want us to continue doing great science and ground-breaking, path-finding research. Our town hall meetings and other feedback allowed us to develop our fundamental questions and to firm up our vision. And, from that we developed our strategic plan.

We take that plan very seriously. It is not just an exercise, it is a living document -- a contract between NASA and its employees, and the Administration, the Congress and the American people.

The second major step in the revolution at NASA was a thorough internal review of Agency operations. Done by NASA people. With nothing untouchable. No holds barred! They looked at every job -- where we do it, how we do it and why we do it. The goal was to restructure the Agency in a way that made sense. And that process is on-going. Right now!

The primary recommendation was that we employ the concept of "Centers of Excellence." That we eliminate duplication and overlap of functions. That each NASA center have a well-defined role. That each Center become pre-eminent in its area within NASA and, in MY vision, throughout the world! Headquarters will function as the corporate office outlining the "what's" and "why's" of Agency policies and programs. The Centers will define and implement the "how's," with both full authority and full accountability. This is the most effective way to run the Agency. Again, this is where we are heading.

But, business decisions and restructuring can only go so far in achieving improved performance and productivity. How is NASA going to achieve the 10, 20 and, even, 30-fold increases in efficiency and productivity that are at the heart of our vision for the NASA of tomorrow? This is where the crucial concepts of a knowledge-based economy and the use of information technologies comes in. These powerful tools hold the key to achieving our vision and moving forward, EXPONENTIALLY, into tomorrow.

So let me say a little about Information Technology (IT). For it is vital to NASA's future, to California's future, and to the Nation's future. In the case of NASA, Information Technology IS our future.

What is Information Technology? One definition might be that it is the use of computers to scientifically analyze information, to make decisions and to aid in scientific thinking. IT will eventually permeate every aspect of every NASA mission. But let me focus on a few areas that will illustrate the power of this new approach.

In the area of data handling, transmission and management, the information technology revolution is already well underway. We used to collect and distribute raw data -- every single BIT of it. When you are talking about terabytes of information, that is very expensive. In the future, we will process data at the collection point -- on the satellite or the aircraft -- and transmit INFORMATION, not data products. This will reduce the volume of transmitted data on the order of 10 to 100 times. We will also be achieving data rates that are 10 times faster than current ones within the next ten years. Databases will KNOW what information is stored in them, and we will be able to ask information management systems intelligent questions that get informed answers. This may sound like "Buck Rogers," but the groundwork for most of these advances is already completed.

Information technologies will revitalize future simulation and design processes. Researchers will be able to work in collaborative, but geographically distributed design environments. The next generation of advances in ultra computing will provide machines with the capability to work at the pedaflops level, doing 1 million-billion operations per second. This will be supplemented by very high-speed, worldwide data networks. Plus, we will take advantage of human interfaces that fully exploit immersive environments and multimedia dissemination on product development. This will all lead to decreased risk, reduced time to market and lower life cycle costs.

In the area of space operations, we will employ spacecraft that can "think" for themselves to monitor their own health and prescribe their own cures. They will only "call home" if they cannot solve a problem onboard themselves via automated fault detection and repair. This will have tremendous implications for reducing costs, eliminating the army of operators who must now standby ready to swing into action if they are needed. Further, when human intervention is needed, we will have the capability to use telepresence and virtual techniques to address the situation. Advanced information technologies will enable us to "transport" the "sensory individual" to the needed location while the "physical person" stays safely and inexpensively on Earth, free to do other things when the situation has been corrected. On Earth, these technologies will give rise to the worldwide (or, even, universe wide) office, wherein colleagues from all locations will have the opportunity to work together without expenditure of time, travel or scarce resources.

Let me speak to one basic area where information technology may well prove vital. Aeronautics. It is a 100-billion-dollar-a-year global industry. At one point, American companies dominated this market -- a critical market that contributes more positive impact to our balance of foreign payments than any other. But, America is losing its grip on this market. In the past 25 years, we have lost one percentage point per year, down from 93% to 68%, in the long-haul, jet transport business. In the next 15 years, there will be about a trillion dollars worth of business to be done in this market. And supersonic transports may add another quarter of a trillion dollars. This is business that is critical to the American economy. But to turn around the present trend and to capture this business, we will need the most superior technology in the world. Information technologies

have the capability to provide domestic companies with the best manufacturing procedures at the lowest cost, with the absolutely vital advantage of being first to market. But, no one aeronautics company can or will do this alone. NASA must lead the way, and information technologies must be the vehicle by which we do it, or it simply won't happen.

Well, I could go on and on. The uses and applications of emerging information technologies are simply unlimited. NASA will not be doing this alone; industry is and will be the real leader. What NASA WILL be doing is increasing our own efforts in the field. We'll do this by taking full advantage of everything that industry is doing and by partnering with industry to develop what we need.

At this point, let me take a slightly different path and talk for a while about NASA's commitment to and involvement in California. In short, NASA has major technology investments and assets in this state. Excluding NASA Headquarters, the Agency has ten field centers. That leaves most states without even one. No state has two. California has THREE.

At the Dryden Flight Research Center in Palmdale, CA, co-located with Edwards Airforce Base, NASA is consolidating the Agency's aircraft operations and flight research. This is the one NASA center that is actually projected to grow over the next few years.

At the Jet Propulsion Laboratory in Pasadena, CA, NASA has focused virtually all unmanned planetary missions and operations.

And Ames Research Center in Mountain View, CA, has been selected to be the Agency lead in the critical area of Information Technology.

This is a major commitment on the part of NASA to the state of California, I'm sure you'd agree. But, it is has a solid foundation. NASA's mission is technology driven -- NASA's future success depends on leveraging innovative information technologies. And California and Silicon Valley are the heart of the Nation's innovation engine. It's a perfect match!

All NASA missions are critically dependent on information technologies if NASA is to lead the Nation forward into the next century and accomplish its mission within diminishing budgets. We

must exploit the power of information technologies to explore the unknown and to pursue our vision.

Let me reiterate just briefly. New integrated design systems are essential to enable development of a revolutionary new generation of small, inexpensive spacecraft. New commercial and military aircraft must be brought to the market place in less time and at lower costs. New simulation and information management tools are needed to help us sustain and improve the quality of life on Earth with knowledge gained from the vast data sets that we are gathering about our environment and how it is changing. And new space systems must assist humankind in the exploration of our solar system, helping us to determine if life is unique to planet Earth. Those are our challenges.

One way in which NASA is pursuing these and other goals is through the establishment of a Center of Excellence (COE) for Information Technology at Ames Research Center. The COE will be NASA-wide in scope. It will bring together the best and brightest in NASA, industry and the universities to meet and overcome these great challenges. The COE at Ames will specifically address and develop new information technologies in aerospace integration and design systems, aviation operations systems, simulation and information management, space systems operations and autonomous systems for space flight.

Industry and universities will be strategic partners in the information technology Center of Excellence. And the new way of doing business within NASA will be the hallmark of COE operations, enabling the development of creative new technology development partnerships while shucking off many of the government's old bureaucratic burdens and regulations.

In July, a broad Memorandum of Understanding will be signed at the IT Center of Excellence launch in Silicon Valley with CEOs, university leaders and community representatives. It is our hope that the President will be available to join us on that momentous occasion.

I should point out that innovative partnership agreements with industry and universities are certainly nothing new to NASA or to Ames Research Center. In fact, in the Bay Area Digital GEoResource project (BADGER), Ames is working with NASA Headquarters, Goddard Space Flight Center, Lockheed Martin and Advanced Information Systems Corporation to develop a low-cost, practical,

electronic approach to sharing geographical information (maps, imagery and databases) across the entire 10-county San Francisco Bay Area region.

Another partnership for which NASA has been the catalyst is the Broad Alliance for Multimedia Technology and Applications (BAMTA). BAMTA grew out of a challenge I issued to John Young, former CEO of Hewlett Packard, Dr. Harry Saal, Chairman of Smart Valley, and other Silicon Valley executives and CEOs in early 1995 to work with Ames Research Center to developed a networked multimedia alliance. I pledged seed funding to that venture if they could come up with matching funds. Within three months, they had 49 member companies, over $2 million in private contributions and had grown into a global collaborative.

Just recently, Ames Center Director, Dr. Harry McDonald, acting at my behest on behalf of NASA, signed a cooperative agreement with Silicon Graphics, Inc., a major workstation manufacturer, to develop innovative information technologies for the future. I am confident this partnership will result in the emergence of integrative media technology to an unparalleled level, advancing multimedia applications well into the 21st century.

Finally, today I am announcing the signing of an agreement with the University of Southern California's Integrated Media Systems Center (IMSC) establishing a partnership with NASA, the National Science Foundation universities and private industry to develop cutting-edge, integrated, multimedia technologies that will be applicable well into the next century. IMSC is collaborating with 40 leading Silicon Valley and Los Angeles-based companies to develop advanced interactive media technologies that combine, deliver and transform information in real time via images, video, audio, animation, graphics and text. This will establish a rock-solid foundation in California for the development of multimedia technologies that will be at least the equivalent or better of anything, anywhere in the world.

In closing, let me say just one more thing about the new NASA, for I am proud of our Agency and its people. When I became Administrator in 1992, we had only two planetary missions scheduled for the rest of the decade, each costing well over 1 billion dollars. Today, we have 10 missions scheduled at an average total cost of approximately $130 million per mission. And all will be up and flying by 1999, not ten or more years down the road! We have

effectively employed leap frog and information technologies. Not to harm NASA, as some would contend. But to sweep away the old ideas, transform the Agency, keep faith with the tax payer and put the dream back out there for all of the American people.

As long as I remain NASA Administrator, we are going to keep partnering with industry, and we are going to keep right on pursuing the new course. We owe it to the American people. It is the RIGHT thing to do.

It has been a real pleasure for me to speak with you here today. I appreciate the opportunity. And I wish you every success with this important summit.

Thank you for your attention. And good afternoon.

Sacramento May 29, 1996

Acknowledgements

- Dr. Robert Whitehead Aero
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- Jason Kessler

Julie Wright
California
Feel sense of vibrancy in economy
Feel unique lifestyle
Feel refreshed

Reminds me of experience of few months ago

→ California crucial to future of nation
→ California crucial to success of space program
→ California is on the move.

→ Change in air
Govt / industry / academia partnerships

To deals with change we must understand forces driving it /

Nothing brings home the difference experience than recent trip to South America.

Brazil / Argentina / Chile

Cold war ending
new age uncertain

- MTCR ownership
- peaceful uses of space
- technology to enhance quality of life not threaten it

In country visits
Chile space program
Argentina 3 1/2 / 3 / 9 mos
Brazil 100 → 200 M/yr

worldwide connects
not exclusively US
No more cold war alliance
Must own relationships
- US launches
- US technology
- share data with US

While in Chile invited to

Astronomy observatory at Tololo
(by Autra)

ride
sunset
academic setting / excitement
no background light or air pollution
stable air
southern sky

Stood on catwalk around telescope

- Quest of human species to understand universe & their place in it
- Creativity spurred by beauty & peacefulness of setting
- what a time to be alive
  - planet finds
  - promise of technology

- supernova 1987a
- moon

Things changing
virtual presence
electricity
internet
maintenance only

Are we moving forward YES
Can we still be inspired YES
Is change going to be default YES

100's miles away
Europes building even
greater observatory — Great

{ Change here don't fight it
Don't yearn for good old days
Move forward

5 driving forces

(1) Cold war ending
Period of transition 10yrs?
Berlin wall - end competition/hipster
SSX - start yes / no
sharp edges
survival of
freedom

~~correct~~

- correlate tech investment with survival of freedom
  - × education
  - × long range American investment
  - × Industry / Govt partnership
    - Apollo → 7% fed budget (- .9% ↓ now)

chip technologies
computers
materials
communications
no more

Σ risk research + product development + production startup

Major corporations joined effort
- Dupont
- AT&T
- ⋮

× relations among nations
- friend / foe
- competition
- bipolar

open markets driven by excellence

new markets
- Russia
- former CIS
- China
- ⋮

(4) Globelizati

- domestic market dominated ecomy
- US prodcivity / tech huge dominated world markets
- Best quality at best price

circuit city

~~WSJ china - steel wool pads~~

ecomy of scale drives need
custmrs / suppliers
undrstnd culture

dnt yuct fight WSJ steel wool pads

6) Information Age
3 → 50 info
53 → 1.8% agriculture

20/80	84	% computer in hdwr
80/20	90	
<10%	96	

(d) Technical Obsolesce

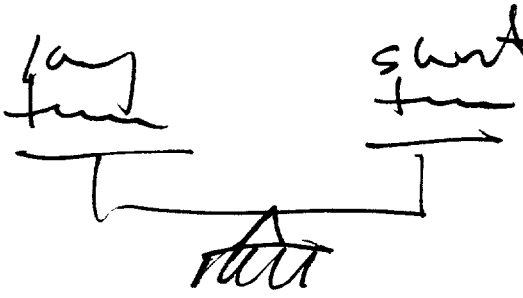
x Mean time to technological obsolesce
- circuit city
  - tape deck ~~amp~~ tuner amp
  - CD amp/tuner VCR
  - CD/video DSC

- NY Times TV es
  - 1/2 hour headline news (cable)
  - technology for communicating

- Mean time to corporate obsolesce
- Mean time to personal obsolesce
- Mean time to national obsolesce

~~this~~
America 2020 robust - yes
who is responsible for America 2020?
" " " Corporations 2020?

Need



shareholder value
sustainable growth/dev for nation

→ Education impact · irreversible
long term tech/science no feedback

can't have static corps.
Stability
can't have static education
can't have only near term go-go
(see mvt)

(e) world's population

2 → 6 → 12
1940 now 2040

opportunity

who is responsible

NASA (10, 20, 30 yrs

· 25 yr. strat plan

Basic Questions

Talking Points For D G DFRC 5/31 Visit

Strategic Rebalancing of Aeronautics Enterprise

Past 5-10 years

- Dominate Emphasis on Opportunities and Needs In Civil Aviation
  - Economic Competitiveness of U.S. Civil Aircraft Industry in a Global Market Growing
  - Technological Opportunity for Break Through on New Generation HSCT
  - Critical National Need for Modern, Safe National Airspace System
  - Revitalization of General Aviation Industry

Next 5-15 Years

Three-Pronged Strategy for Balanced, Long Range Aeronautics Enterprise Leadership R&T

1. Sustainable Leadership for Civil Aviation
   - Stretch Civil Industry Technology Vision
   - Mitigate Technology Risk in Economic Equation
2. Facilities, Expertise and Research Vision to Support National Partnership with DoD
   - Provide New Technical Application Opportunities
   - Integrate Dual Use Investments
   - Leverage Federal Investment in Aeronautics R&T

3. Technology to Integrate Atmospheric and Space Flight for Launch Vehicles
   - Hypersonic Airbreathing Propulsion
   - Advanced Materials and Structures
   - Aeronautical Operating Principals (Utilization, etc)
   - Vehicle Systems Integration

Approach

- Focus on Systems Benefits / Added Value from Research
  - Customer Input / NASA Decisions

- Maintain National Design / Build Innovation and Skills in Time of Fewer Large Production Programs
  - Design / Build / Test Iterations

- Renissance in Aeronautics
  - Emphasize Flight as Integral Part of R&T
  - Remove Cost / Time Barriers to Flight As A Research Tool
    - * X-Planes
    - * Pilots only to Add Value
    - * Rapid Prototyping / Reconfiguring for multiple flight Iterations

- Emphasize National Partnerships (DoD, FAA) to minimize Costs & Share Benefits
  - Facilities and Programs

For DFRC

- Unique Role for Agency and Nation In Flight Research
  - National leadership and Core Competency for Flight Research
  - Agency leadership for Flight Research Operations
    - X-Vehicles
    - Research Aircraft
    - Platforms for Airborne Research
  - Full Partner In Renissance in Aeronautics

Talking Points for Dryden

- Dryden is celebrating its 50th year of flight research this year.
- A handful of people came out to Muroc Lake to participate in the X-1 program.
- The contributions of Dryden continue to be as important in the '90's as much as they were in the '40's.
- Just in the past year Dryden has
  - Demonstrated propulsion controlled aircraft landings on an MD-11, which will contribute to the safety of future aircraft
  - Conducted a joint flight program with Langley on vortex control, using strakes on the F-18 HARV
  - Evaluated advanced actuator systems on the F-18 Systems Research Aircraft, working with the industry and the DoD.
  - Achieved a world altitude record for solar powered aircraft when the AeroVironment "Pathfinder" aircraft climbed above 50,000 feet.
  - Conducted the first fight tests of an advanced multi-axis thrust vectoring nozzle on an F-15 in a joint program with Pratt and Whitney and the Air Force.
  - Achieved laminar flow on the F-16 XL at supersonic speeds in a joint program with NASA Langley and the U.S. industry.

You also continued to provide flawless support to the space shuttle program as an alternate landing site.

Your people also found a way to provide communications support to the MIR station.

Dryden has been successful in forging partnerships with other Centers, other government agencies, and the U. S. industry to both develop technology and transition it for application.

Dryden is also working with MSFC on the reusable launch vehicle program. You also recently demonstrated an advanced thermal protection system for the X-33 on the F-15B. The tests of the Aerospike engine on the SR-71 will provide the first flight data ever, for this concept.